E. M. Baker

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to bring out the effect of those spots. I find we do that at from two to four amperes per square foot. Every time you change back you have pits. This is all the same solution. I am in the habit of giving that solution a dose of half a pound of sodium perborate per hundred gallons solution each week. I will give you all the particulars as I remember them. I will take that work; we will do bright work at about ten to twelve amperes per square foot. We get the other work in there and the solution will pit before the second run comes out. If we do that work alone it will plate bright again before the second run comes out. We have to add more sodium perborate to the solution, about a pound per hundred gallons, to keep it going for a couple of days. I just mention that. I thought it might throw some light on the subject.

MR. LISCOMB: What percentage of nickel anodes are you using?

MR. TERDOEST: One tank ninety-seven and the other one ninety-nine.

MR. LISCOMB: Supposing you had an anode in there that contained a lot of iron, it is quite possible that if you would raise that pH a little bit and then throw in the hydrogen peroxide and then this organic matter we mentioned, your pitting might stop.

MR. TERDOEST: We work it at about pH 5.7.

MR. LISCOMB: You would have to raise it up from that to get the action you wanted with this method of purification.

CHAIRMAN BLUM: There is an interesting subject of pitting on which I know if all the platers said what they thought that perhaps the reporter would have to use absestos paper, but we certainly ought to have some more discussion on this subject of pitting and the purification of solutions.

MR. F. F. OPLINGER: It is interesting to note that the ferric hydroxide treatment spoken of has been used to remove strychnine from poisoned beer; also it will remove lead from a zinc cyanide solution. We simply add the ferric sulphate to the solution and if it forms the ferric hydroxide and precipitates it includes all sorts of material by the time it gets down to the bottom of the container. I recall an article stating that that method has been used for taking strychnine from poisoned beer.

CHAIRMAN BLUM: I might mention that it is well known, and Mr. Liscomb referred to it, that aluminum is used in the purifica-

tion of water to carry down suspended matter. This ferric salt behaves in practically the same way as the aluminum salts.

Is there more discussion of this paper?

MR. HOGABOOM: I think this paper is very interesting. I think it also shows another phase of electroplating to which too little attention has been paid in the past, that is, the purification of the solution or the effect of very minute quantities of impurities, some of which can only be determined by a spectograph analysis, upon solutions. It is well known that electrozinc refining would not have been successful had not various minute traces of cobalt been found in the solution and removed. If you have cobalt, I think it is about one-thousandth of a gram per litre in zinc sulphate solution and if it is recovered with insoluble lead anodes and plated on aluminum cathodes and done in cascades in the fifth cascade the metal will go into solution as quickly as it is deposited. If they remove the cobalt they can go through. Some of you remember the experience of the very minute quantities of uranium in the zinc sulphate solutions reported at the St. Louis meeting of the Electro-Chemical Society, where it decreased, I believe, the efficiency of the cathode efficiency something like forty per cent. Evidently there are some impurities in the solution that are affecting the character of the deposit which, in my opinion, are due to cathode polarization. If you have a cadmium solution and introduce a small amount of aluminum or lead, it can be in very minute quantities, so small that it would not be detected by chemical analysis and yet that would cause cathode polarization. You would get an entirely different effect on the structure and character of your deposit. In this purification method that Mr. Liscomb has suggested, it is, in all probability, as stated by Dr. Blum, that all the impurities are carried down by the iron. Inasmuch as after removing those impurities, especially the iron, pitting was practically eliminated, and in view of the work that was done by Villamer by the addition of iron that was reported at the Philadelphia meeting last year, the addition of iron to a nickel solution where the contractometer was materially affected by its presence, isn't it reasonable to assume that iron that is soluble has a material effect upon the cathode; also that when it is purified and the hydrogen peroxide changes the soluble iron into an insoluble iron it will be precipitated? You are purifying the solution in two ways: first by oxidizing the iron from one state to a state where it can be

precipitated and the other having the pH so the iron will come down as a precipitate carrying all the impurities with it.

Iron may be deposited in a colloidal form. Pitting, as we have said before, can be of two kinds. You can have gas pitting. Look at that under a microscope and you will see the deposit is revealed. If iron or some colloid is deposited, you get this kind of pitting and the deposit tries to bridge across, and when it is wiped off you have a crater effect. Phillips found that in some of his work. I am wondering whether the iron isn't at fault there.

CHAIRMAN BLUM: Mr. Phillips can probably contribute to that.

MR. PHILLIPS: I would say that I think the remedies for pitting are sort of two-barreled. First, you have to have physical cleanliness; and next, chemical purity. I think the more important is the physical cleanliness. By that I mean the work itself should be very clean, not just from grease but from small particles and next the solution should contain no small particles whatever. This is hard to do, I admit, but that is the first step. The next thing is chemical purity. When you come to handling that it makes quite a little bit of difference whether you are dealing with a high or low pH solution. If you are dealing with a high pH solution, Mr. Hogaboom's picture up on the blackboard is exactly right. You will see both of those types of pits on your work at various times. This, I think, is due primarily to the condition of the iron or the presence of the iron. I think Mr. Liscomb has suggested a useful method pertaining to the chemical purity part of the program. You have to have both. Unless you are using a low pH bath, in which case you can stand some chemical impurity in the form of iron, the iron will deposit out, and the tendency is to purify it by deposition all the time.

I think I have stated before that a bath containing even comparatively small quantities of iron, one thousandth of a gram per litre, will, in operation, show a very small amount of iron in a short while. One thing you will notice that is very agreeable is that your throwing power increases as the iron decreases. One of the things that I stated erroneously in my first paper before this Society was that the low pH bath had poor throwing power. It has poor throwing power as long as it has iron in it, but get the iron out and the throwing power increases.

MR. GREENBLATT: I might say something about this pitting in nickel. Years ago I used to work in Germany. We didn't

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MR. GREENBLATT: I might say something about this pitting in nickel. Years ago I used to work in Germany. We didn't

have so much pitting in our nickel solutions as I am getting here, but I found something that I think helps. We only were supposed to use rain water, soft water, for our nickel solution, and I think that it did help a little for that nickel solution. A couple of years ago we had this in Canada when we had our convention there. A man was brought up from a plating plant where the workers had nickel itch on their bodies; the man had it on his hand. The plant managers found out that the trouble came from the water. They had some kind of a zinc pipe connected in their factory that caused the trouble. Maybe it is the hard water we are using. The water is not soft water like we used to use in Germany. Maybe that helps a little with that pitting.

CHAIRMAN BLUM: Is there further discussion of this paper?

MR. CAMPBELL: I would like to ask Mr. Liscomb what other ingredients of the bath beside the impurities are withdrawn in that treatment?

MR. LISCOMB: Of course, you know that as you raise the pH up to certain points the copper comes out. When you get still higher, zinc comes out, even without the iron. Thus it is reasonable to suppose that those will come out when you get the pH high enough. The gentleman here pointed out the fact that you can take something out of the cyanide solution with that treatment. So there are a number of things in addition to the organic matter that will come out. I don't have any figures at hand.

MR. CAMPBELL: Will you take out a considerable amount of your boric acid?

MR. LISCOMB: I don't know. I think so. You ought to know something about what that would do to a solution. He has worked with only 12,000 gallons of it.

CHAIRMAN BLUM: I think that question can be answered, that any iron precipitate is bound to take out some of the boric acid. We found in studying the composition of sludge, there was always some basic borate present, so that undoubtedly you would be losing some boric acid in your sludge.

MR. CAMPBELL: It took out fifty per cent.

CHAIRMAN BLUM: Fifty per cent of that boric acid content?

MR. SIEVERING: I cannot agree with the statements made here that the iron is really the trouble in all your pitting. I will give you an illustration: When I went in the game back in 1877, the purity of the anodes at that time was ninety or ninety-

two, and we had no more pitting at that time with the low purity of anodes than we have today.

There is another thing we may look into and stress. During all my experience in handling double chloride of nickel solution we were not confronted with the problem of pitting, whether with high current or low current. I will give you an instance. When I had charge of the Singer plating department, at the height of my chemical experience, just getting through the studies of chemistry, the firm we bought anodes from at that time had sent us in some anodes, that only contained seventy-five per cent nickel and twenty-five per cent iron. Even with that high amount of iron in the anodes we had no pitting whatever, but we had poor work with this amount of iron. When it was mentioned to the company that we were getting inferior material, of course, they lost our business. But during all that time we never had any trouble with pitting in the double chloride of nickel and ammonia and the sulphate. We had no more at that time than we have today even with the low or high purity anodes.

CHAIRMAN BLUM: Your large amount of iron probably purified the solutions from the things that did cause difficulty.

MR. TERDOEST: I had the same experience and I have worked at nickel plating for over fifty years. When we had the double salt solution we had no trouble with pitting. It was probably due to the low current density that we had no trouble. We did just as good work as we do now, only it took a little longer to do it.

CHAIRMAN BLUM: If there is no objection I find myself in a difficult position. We would like to have unlimited discussion on each of these papers. On the other hand, we have a number of interesting papers ahead, so we will proceed with the next paper. Thank you, Mr. Liscomb. (Applause).

FACTORS CONTRIBUTING TOWARD QUALITY OF PLATED ZINC DIE CASTINGS

Carl Hussner

Read at Chicago Convention 1933

THIS is probably only a summary of a good many things that have been said, trying actually to put into production a good many things that the platers and all the people connected with the finishing of die castings know

In considering the application and use of metals as engineering materials, the designer, in balancing the service and production requirements of a particular part against the physical properties of metals and alloys that will meet those requirements, is often forced to make a choice. This choice, or rather decision as to which shall be specified, is too often a matter of precedent without due regard to the possibilities of economical selection. This is especially true of non-ferrous metals in structural and ornamental application, with beauty and durability of finish as important factors.

In the earlier days of the automotive industry, the use of zinc as such was limited largely to strip for moldings, such as running board moldings where it passed under the nomenclature of "white metal." It was only with the more extended use of die castings and the realization of their possibilities that the use of zinc as an engineering material has been so enlarged. There have been setbacks due to its application to parts to which it was unfitted on the basis of physical properties, but more because of inferior finish and the use of impure metals and bad casting practices.

The above condition has created a very strong prejudice against zinc base castings, so that many parts that can be made from zinc and finished satisfactorily, designed better, and at a great saving are still being made from other materials and by other methods. These prejudices will disappear as soon as all die castings improve in quality and finish, and a standard basis of quality is established. This quality must include the preservation of the metal and surface appearance.

There are three essential factors to be considered in producing a finished zinc die casting of high quality:

1. The casting and the material from which it is made.
2. The preliminary finishing and machining of casting.
3. The cleaning and plating of the casting.

First, the metal and casting must be considered. Most of the modern die casting plants are using metals of high purity as outlined by the S.A.E., or similar high-grade material. Seldom do we find die castings from good shops that have a higher content of impurity than is permitted by the S.A.E. Standard No. 903 or 921.

The following is the percentage composition:

S. A. E.	*No. 903*	*No. 921*
Aluminum	3.5 to 4.5	3.5 to 4.5
Copper	0.10 max.	2.5 to 3.5
Magnesium	.03 to .08	.02 to .12
Iron	Max. 0.10	0.10
Lead	Max. 0.007	0.01
Cadmium	Max. 0.005	0.005
Tin	Max. 0.005	0.005
Total other impurities	Max. 0.02	0.02
Zinc	Remainder	Remainder

The elimination of detrimental impurities or the holding of them to specified minimums, has greatly improved the potential possibilities of high quality die castings. We have little difficulty at the present time with disintegration, excessive warpage, growth, or extreme loss in tensile strength. The credit for the improvement must go to the large zinc producers. They not only produced metal of higher purity, but educated the alloy manufacturers and also the die casters to the idea that impurities could no longer be tolerated.

Complete chemical analysis of fifty different castings coming from twelve different die casters showed that only one sample had an impurity higher than permitted, that being lead. However, an analysis of castings from ten die casting shops which were alloy places and not controlled, most of them making their own alloys from anything they could buy cheaply, showed impurities in all castings. This group will not enter further into this discussion. It is hoped that in the near future one of the fundamental requirements of a die casting shop as an approved source for automotive production, will be metallurgical and chemical supervision.

Now with a good metal with which to start, the die caster must produce a casting with less surface porosity, a deeper surface density, fewer large air pockets, better trimming of the castings, and fewer blemished or slightly blemished castings. This is a large order, but some of the shops are making marked progress, and we are able to secure castings of fifteen to twenty pounds with less porosity today than we found in two and three pound castings of two years ago. Methods and processes of arriving at the above will be left to the die casting shop to work out.

After the castings reach the polishing shop, the first thing done should be a hundred per cent visual inspection of them for blemishes and porosity. Castings that are held to definite

dimensional tolerances will, of course, require such inspection as is necessary to keep within the desired limits. It is important to hold to dimension, or someone that is assembling the job will apply a file or drill a new hole and in a short time the part comes back because it has corroded. Castings with surface porosity should be sent back to the casting plant, and not polished to eliminate the surface defects. Likewise, damaged castings should not be polished to eliminate the defects. Instead, scrap the casting. Of course, this will meet considerable opposition on account of price, but this can be faced. With proper care castings should not be damaged in operation or handling, and the quality of the job obtained by using sound castings is the only quality that can be considered, and the cost of such, favors die castings for many parts.

The good casting should be polished and buffed without going to much depth in the dense outer surface of the casting which is often referred to as the surface skin. The methods of obtaining a highly buffed casting are better known by the men here than by the writer. It is the importance of retaining that surface density that should be kept in mind.

The castings should be moved to the plating department as soon after polishing as possible in order to prevent any tarnish, and great care should again be exercised to prevent the damaging of the parts. The parts should now be thoroughly cleaned. There are many good cleaners available and many methods which are satisfactory. However, a few things should be given consideration.

1. It is as bad to overclean as to not clean enough.
2. The use of contaminated cleaning solutions is very detrimental especially, contaminations of a metal which will deposit to the casting by immersion.
3. Rinsing of the casting after cleaning in order to prevent possibilities of the formation of zinc salts on the surface or in the pores of it is very important.
4. Of course, it is important that all grease, grit, and compounds be removed from the casting before plating.
5. A suitable etch dip shall be given the casting.

With these precautions, the castings should be in good condition for plating. They shall not, however, have a lapse of time between the cleaning and plating operations.

There are many opinions and many types of quality or lack of quality used in the present methods of die cast plating. Castings selected from the twelve die casters previously mentioned were plated in various shops throughout the country. The quantity of plate on these was approximately from .0003 to .0005 inches thick. These castings were finished according to the practices of these individual shops. They were then exposed on the roof of a New York building and observed weekly with the following results:

The first castings failed after six days exposure; others failed after ten days, while some of them lasted forty-three days without any sign of failure. These figures are given only to show that there are other qualities to be considered as well as the depth of the plate.

Some of the castings that failed in six days and some that required forty-three days before failure were identical before plating. They had approximately the same depth of plate but yet we have this big variation in quality.

Another group of castings, cast by the same die casters, were all carefully inspected, properly cleaned, and plated with varying amounts of nickel, the amounts varying from four grams to twenty grams of nickel per square foot. The amounts of nickel over eleven grams, however, were plated in a laboratory way and were not taken from production operations.

Other castings were given first a ten gram deposit of copper and then plated with nickel in amounts varying from two to twelve grams for each square foot. Upon exposure tests and service tests, the castings plated with twelve grams of nickel were as durable as the castings with first copper and then the twelve grams of nickel. The castings with the twenty grams of nickel have not failed to date after one hundred and forty days of exposure. The castings with plates with less than ten grams of nickel per square foot failed in from twenty-six to seventy-eight days, while those with approximately ten grams of nickel per square foot showed no failure for the first hundred days. These figures would indicate that the durability was in direct relation to the quantity and quality of the nickel deposited. (NOTE:—All the above castings were plated with approximately two-tenths of a gram of chromium per square foot.)

The above paragraphs are only a brief summary of a few of the tests that have been conducted to determine what quality

of finish is satisfactory on zinc die cast parts. An effort has also been made to correlate laboratory tests with service requirements. So far, these tests have been variable, but a few things are quite definitely established. The results of the salt spray test vary extensively, and it appears as though the only merit of this test would be to show extreme porosity in a very short period of time. The determination of the depth of plate without determining the quality of that plate does not give us a true idea of the serviceability of that part. It is not the writer's idea at this time to abandon the salt spray test which is very widely used, but to have other tests used as general procedure with it.

In order to obtain a good and durable nickel deposit upon a properly prepared casting, the following things are essential:

1. That no strike coats that are frequently used at present, such as copper or brass, be used.
2. That the electrical mechanism of the tanks be properly controlled.
3. That the solution be kept reasonably free of zinc.
4. That with the present type of nickel die cast solutions, they be operated with a high pH concentration.
5. That the nickel deposit be kept free from other contaminations.
6. That the solution be so controlled that there is a very limited amount of deposition by immersion.
7. That the relation of the current density, temperature, and concentration of the bath be such as to produce a fine grained structure with a minimum amount of cracking.
8. That laboratory and shop control be so regulated as to produce uniform plate.
9. That the deposit be checked for quantity of plate, contamination, and brittleness.

   (NOTE:—The quantity of plate desired shall be determined by the service requirement of the part, but in no case shall a casting have less than five grams of nickel per square foot.)

The points stressed in this article are not new or revolutionary, but are simply the minimum essentials to obtain a finished die casting of high enough quality to make it satisfactory for reasonable service. (Applause)

CHAIRMAN FRAINE: Are there any questions in regard to Mr. Hussner's paper? I think it is a rather valuable contribu-

tion to our papers here today and I am particularly interested in it because in checking over the papers that are presented at this meeting we find that a large proportion are coming from the automotive industry. That is reasonable to expect in a way because of the great advance in the automotive industry and the problems that are arising in connection with their business. So we have to thank that industry as a whole, I think, for helping out greatly on the convention papers.

MR. SERVIS: I would like to ask Mr. Hussner a question. You stated the number of castings on tests that did not fail within 120 days or something like that; others failed within six days and ten days and yet the plate was the same in quality.

MR. HUSSNER: I said the depth of the plate was approximately the same, but the quality of the test will show it is very different.

MR. J. H. HOEFER: Do you favor the deposition of nickel directly on the die cast as compared to the copper or brass cast?

MR. HUSSNER: Our specifications will give the operation of a nickel direct on a copper plate. We at no place give brass a consideration. They use copper as permissible providing it is a heavy layer.

MR. E. G. ANDERSON: Dr. Hussner's paper is very interesting from a number of viewpoints. In the first place, it represents the opinion and findings of a plate man. It isn't something that was concocted in a laboratory. It is something that came out of actual service experience. You will notice the results he gives, the comparison he makes, and the conclusion he draws are based on service and outdoor exposure and not on accelerated tests. There are three, I might say, and my purpose in discussing Dr. Hussner's paper is not to comment on anything except the salt spray test. I have come to bury it if I can. I can cite you three instances where Dr. Hussner's service data and the salt spray data depart. A short time ago we obtained three lots of castings of varying quality. We plated them identically in the same tank at the same time. We exposed them to salt spray. Every one of the castings showed white salts in eight hours, blistering in twenty four hours, regardless of what casting it was. We put them in the outdoor exposure. At the end of two months, the first porous casting showed failure. The next failed in four months and the best in seven. Is there anything in the salt spray that could have predicted that? There is absolutely nothing. The salt spray gave

the same result for all of them. Dr. Hussner shows that with one plating method increasing thickness of coating with nickel direct increases the surface life. A short time ago we obtained a lot of castings, several hundred of them, which we plated by seven different nickel methods, including additional variations in buffing procedure to thickness of coating, ranging from two grams to twenty-two, and put them all in the salt spray. They all failed in six hours regardless of what we did to them. Is there anything there that will tell you a story?

This third case is that of the copper-nickel. Apparently from Dr. Hussner's results as well as the results of the Society's tests on steel there is a slight advantage in favor of nickel direct over copper. We won't dispute that, but anyone who has run salt spray tests on copper-nickel and nickel direct will find the salt spray life of the copper-nickel approximately three times that of the nickel direct, which is not justified by service experience.

There are three places where the salt spray test either hasn't told anything or has told a downright lie. Dr. Hussner has wisely pointed out that the whole story of the durability of the coating is not in the thickness. Thickness for thickness there may be variations in quality. There is some measure required for the durability of the coating besides thickness.

The point I don't agree on in the salt spray is the measure. It can be pointed out that a man who measures only the thickness of coating doesn't know all there is to know about the quality of his product. It can equally well be pointed out that a man who runs the thickness of coating and the salt spray test still doesn't know anything about the quality of his product. (Applause)

MR. DEGRATIO: He brought out that most of our trouble, I think, comes from the foundry.

MR. B. G. DAW: In a lot of these soft castings when you try to buff them you see a pin hole and when you take it out you see a sponge underneath. I say they should go back to the foundry; eighty-five per cent of our trouble is due to that.

MR. SPENCER: I would like to ask Mr. Anderson or Dr. Hussner what he means by quality of nickel plating. Does that mean uniformity of the coating in its freedom from porosity? Does he mean the microstructure of the deposit as regards fineness of grain or coarseness? How does he judge the quality of the plate?

MR. HUSSNER: You might take both of them as factors of the

quality, both your microstructure and the porosity of the deposit, but we will be satisfied to call anything quality that you can produce that will give us the life, the service life, of that finished part. It is true that your structure of that plate will be important and also the elimination of porosity in that surface of the plate.

MR. JAMES E. NAGLE: Have you found, Mr. Hussner, whether a casting that was so shaped that it plated well all over had a better life than a casting in which there was a reduction of zinc going on on the inside of the casting? In other words, wouldn't the reduction of zinc on the inside of a hollow casting have a tendency to destroy the skin surface on the inside of that casting and cause corrosion on the inside of the plate?

MR. HUSSNER: I don't know how it causes it, but I think from the trouble that everybody has had with hollow castings, such as tail lamp brackets and a good many head lamp brackets, there is something that doesn't come up to the casting that is solid, and you will at once get a plate over the whole surface of that casting, because if you will look around at the tail lamps of most anybody's car you will find that there is a certain amount of failure starting after a very short time.

MR. PHILLIPS: I would just like to discuss the paper a little bit. It seems to me there has been a question of quality raised here that is very important. We don't know just exactly how to control quality and in lieu of that the thing needed still seems very important to me. If we knew just exactly how to control this rather indefinite thing we call quality we could probably get along without much thickness. But at the present time if you have a core either started in the base plate by a hydrogen bottle or by the factory casting, it has been my experience if you put on a plate the core becomes smaller and, without further information, I should say that I would still insist on a pretty heavy plate. How about it?

MR. HUSSNER: I agree with you.

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IN the year 1883 Frederic B. Stevens, the foundry supply manufacturer, decided to make the plunge into the realms of industry and become a business man in his own right. How he has progressed needs no comment. Mr. Stevens is what some would call a down-east Yankee, having been born, raised and educated in Connecticut. Before allowing himself to become old he followed the injunction of the old sages to "Go west, young man." While Detroit is not "out west," it is west of Connecticut, and here he settled. To tell the story of his life would fill a large volume, and would not serve the purpose we are endeavoring to serve. Needless to say he mastered the foundry business. He worked in the foundry office, in the purchasing department and learned what foundries required. He worked in the foundry itself seven years and learned how the supplies were used. In fact he learned the foundry business from A to Z.

He sold pig iron. The pig iron business suggested foundry supplies, as many who bought pig iron asked him for foundry supplies. So he began handling and ultimately making foundry supplies. Later many to whom he sold foundry supplies asked him for plating and polishing supplies and this suggested handling and finally manufacturing these commodities along with his lines of foundry supplies and equipment.

Face brick came next. Building operations were active, to build became so interesting so entrancing, that the construction of big buildings, of apartment buildings, and of homes, followed fast, in which there was nothing like Stevens vitrified face brick to aid in the good work, possessing the essential qualities of economy, durability and real beauty in shades of color from delicate to daring, rough-faced, smooth-faced, Janus-faced, weather-proof, fire-proof, rat-proof and fool-proof. Large stocks of face brick are now carried and wall panels are shown in the display rooms.

The facing mills at 2530 Twenty-second street, like Gaul, is divided into three parts, the facing mills, where the grinding of crude foundry materials takes place, the engine and boiler rooms, and the sea coal factory. The newest and most improved bolting machinery is here installed, the last word in fine equipment and efficiency.

The general offices and warehouse comprise a 4-story building at Third and Larned streets, with showrooms and large warehouse stocks. Adjoining this is the 3-story buffing compositions factory for the manufacture of buffing compositions and platers' and polishers' supplies. Automatic machinery is used—practically everything is done automatically, many of the machines being of original design. Here, also are the chemical laboratories, where, with formulas carefully worked out, the automatic machinery operates with precise calculation and unfailing exactness. From this factory is derived much of the perfect work one sees on automobiles, stoves, brass products and the products of other great industries throughout the land.

A Canadian company warehouse, facing mills and buffing compositions factory is established at Windsor, Ont., with a branch office and warehouse at Toronto. Other branches are maintained at strategic points, Indianapolis, Erie, and New Haven, where ample warehouse stocks are carried.

Automatic plating machines are also manufactured, the latest being the new universal return type for plating, cleaning, pickling or dipping, a marvel of simplicity and efficiency.

Early in his career as a saiesman, Mr. Stevens traveled quite extensively in eastern United States and in Canada, where he made many friends, some of whom still remember him personally and write him personal letters. Mr. Stevens was always a likeable sort of a fellow, and he never was a fellow to light his candle and put it under a bushel. He was in the supply business and he let the world know it.

He is president of Frederic B. Stevens, Inc., Detroit, and president of Frederic B. Stevens of Canada, Ltd., both of which grew up together. Following the lead of their president, these organizations adhere to the doctrine that "Advertising is the keynote of success." And they advertise in the MONTHLY REVIEW and wherever business seems likely to be had.

Mr. Stevens and his entire organization have always been conspicuous as leaders in boosting the American Electro-Platers' Society and are amongst its strongest supporters both morally and financially.

We congratulate the President and the F. B. Stevens Co. on half a century of progress.

SUMMARY OF COURSES FOR ELECTRO-PLATERS

Given at the Bureau of Standards
By W. Blum and Associates
To Baltimore-Washington Branch of the A. E. S.

I. Introduction

At the request of T. F. Slattery, Vice President of the American Electro-Platers' Society and Chairman of its educational committee, the following outline of courses given in Washington was prepared. It is being sent to the secretary of each Branch in the hope that it will be helpful to those who are giving or planning courses for electroplaters.

The scope and order of the courses were determined largely by expediency, and are not specifically recommended. It will be noted that there was considerable repetition which however proved advantageous. In general it appears desirable in a period of a few years to first consider elementary principles and methods then detailed methods of analysis and finally the more advanced principles. Whether such a cycle can be repeated at intervals in any Branch will depend upon the interest and progress of the members.

In connection with these courses, mimeographed directions were supplied for each experiment, including spaces for recording data. There are not sufficient copies of these detailed lessons for general distribution. If, however, more information is desired regarding any course or specific lesson, this will be furnished on request addressed to W. Blum, Bureau of Standards Washington, D. C.

Attention is also called to the directions for the analysis of nickel, cyanide copper, brass and chromium plating solutions prepared in 1931 by the Bureau of Education of the American Electro-Platers' Society. Copies can be obtained at $1.00 each by writing to T. F. Slattery, Bureau of Engraving and Printing, Washington, D. C.

II.

1928-1929
General Principles
Laboratory and Classroom

Eight lessons, including one review

Lesson:

I — Measurements involved in laboratory work. English and Metric Concentration of Solutions. Density of Solutions. Temperature of Solutions.

II — **Changes in Matter.**

(1) Physical changes

Melting, boiling, condensation.

(2) Chemical changes

Combination, decomposition, double decomposition, neutralization.

III — **Chemical Analysis.**

(Illustrated with a nickel solution)

(1) Nickel Determination.

(a) Electrolytic

(b) Volumetric (cyanide)

(c) Colorimetric

IV — (2) **Chlorine Determination**

Volumetric (silver nitrate)

(3) pH Determination

Colorimetric

V — **Principles of Electricity.**

(1) Ohm's law

(2) Series and parallel rheostats

(3) Series and parallel baths

VI — **Principles of Electrochemistry.**

(1) Faraday's law

(2) Cathode efficiency

(3) Resistivity — Haring cell

(4) Polarization — Haring cell

VII — **Throwing Power.**

(1) Compare regular and high-sulphate nickel baths in throwing power box.

(2) Plate cylindrical soap boxes in same solutions.

III.

1929-1930 — Experiments on Chromium Plating

Laboratory and Classroom

Seven lessons

I — **Effects of Temperature and Current Density on:**

(1) Cathode efficiency

(2) Bright plating range

(3) Throwing power (bent cathodes)

II — **Effects of Concentration of chromic Acid on:**

(1) Cathode efficiency

(2) Plating range

(3) Throwing power

III — **Effects of Concentration of Sulphate on:**

(1) Cathode efficiency

(2) Plating range

(3) Throwing power

IV — **Effects of Trivalent Chromium and Iron on:**

(1) Cathode efficiency

(2) Plating range

(3) Throwing power

V — Deposition of Chromium on Different Base Metals
(Copper, brass, steel, nickel):
(1) Throwing power
(2) Effect of cleaning methods on adhesion
(3) Porosity of various metal deposits on steel (Ferrocyanide test).

VI — Methods of Analysis:
(1) Chromic Acid
(a) Specific gravity
(b) Electrometric
(c) Titration with $K_2Cr_2O_7$ and an inside indicator
(d) Titration with $KMnO_4$

VII — (2) Sulphate
(a) Gravimetric
(b) Centrifuge
(d) Turbidimeter

IV.
1930-1931
Analysis of Electroplating Solutions
Laboratory and Classroom
15 lessons, including 1 review

Lesson:

I — Use of Apparatus:
(1) Bunsen burner
(2) Manipulation of glass tubing
(3) Volumetric Apparatus
(a) Graduated cylinder
(b) Pipette
(c) Burette
(4) Balance
(5) Thermometer
(6) Hydrometer

II — (1) Sampling
(2) Acidimetry
(3) Analysis of an alkaline cleaner
(4) Analysis of an acid pickle

III — Acid Copper Solution
(1) Acid titration
(2) Copper sulphate from specific gravity
(3) Titration of copper (with thiosulphate)

IV — Nickel Solutions
(1) Determination of nickel
(a) Volumetric (with sodium cyanide)
(b) Colorimetric

V — Nickel Solutions
(1) Determination of chloride
(titration with silver nitrate)
(2) pH determination (colorimetric)

VI — Silver Solutions
(1) Free cyanide (titration with silver nitrate)

(2) Silver (precipitation as sulphide, solution and titration with thiocyanate)

VII — Cyanide Copper Solutions

(1) Free cyanide
(2) Copper (titration with thiosulphate)

VIII — Gold Solutions

(1) Free cyanide
(2) Gold (titration with thiosulphate)

IX — Acid Zinc Solutions

(1) Zinc (titration with potassium ferrocyanide)
(2) pH Determination. (Colorimetric, with brom phenol blue)

X — Cyanide Zinc Solutions

(1) Zinc (titration with ferrocyanide)
(2) Total cyanide (titration with silver nitrate after addition of alkali)

XI — Cadmium Solutions

(1) Cadmium (titration with ferrocyanide)
(2) Free cyanide (titration with silver nitrate)
(3) Combined cyanide (titration with silver nitrate after addition of ammonia).

XII — Brass Solution

(1) Free cyanide
(2) Copper and zinc

XIII — Chromium Solution

(1) Chromic acid
  (a) From specific gravity
  (b) Titration with permanganate

XIV — Chromium Solution

(2) Sulphate
  (a) Gravimetric
  (b) Centrifuge

V.

1931-1932

Principles of Chemistry

Lectures, Discussions and Problems

Eight Lessons

Lesson:

I — Matter

(1) Definitions
(2) States of matter
(3) Properties — physical and chemical
(4) Kinds of matter — elements, compounds, mixtures, solutions
(5) Structure of matter
(6) Changes in matter
(7) Conservation of matter

II — Energy

(1) Definition
(2) Transformation
(3) Utilization
(4) Electricity

(a) Primary units
(b) Ohm's law
(c) Secondary units
(d) Faraday's laws

(5) Electrolysis
(a) Parallel and series tanks
(b) Three-wire system
(c) Heat produced
(d) Polarization

III — Chemical Symbols and Calculations
(1) Symbols and atomic weights of elements
(2) Formulas and molecular weights of compounds
(3) Percentage composition of compounds

IV — Chemical Equations
(1) Principles
(2) Use in calculations

V — Kinds of Chemical Compounds
(1) Binary
(2) Valence
(3) Oxidation and reduction
(4) Electrolytic dissociation

VI — Acids, Bases and Salts
(1) Acids
(2) Bases
(3) Salts
(4) Formulas of salts
(5) Acid and basic salts
(6) Normal solutions

VII — Analysis
(1) Qualitative Analysis
(a) Typical tests
(2) Quantitative Analysis
(a) Principles of gravimetric, volumetric and colorimetric
(b) Applications
(1) Acidimetry
(2) pH — Hydrogen ion concentration

VIII — Analysis
(3) Oxidation and reduction
(4) Precipitation methods
(5) Cyanometric methods
(6) Colorimetric methods

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ABSTRACT SECTION

EDWARD B. SANIGAR

These abstracts are mostly adapted, by permission, from "Chemical Abstracts", the references to that publication being given in the form — *C. A.*, **27,** 3402 (1933) *i. e.*, Chemical Abstracts Volume 27, page 3402 in the year 1933. The name appearing at the end of the abstract is that of the abstractor. Abbreviatons for scientific journalsare those used by "Chemical Abstracts" (see *C. A.* **25,** 6019 (1931)). E. B. S.

Recent experiences in the field of silver-plating. "Galvanicus" *Oberflächentechnik* **10,** 165 (1933).—Recent experiments have shown that attempts to replace the cyanide bath now generally used, by baths of sulfates, nitrates, fluorates and fluorides, have not led to any practical solution, as they do not give the fine structure of the cyanide bath. The latter was investigated with respect to bath resistance, polarization and throwing power. The resistance does not depend upon the current but only on the composition and and temperature of the bath; it changes about 2% for each degree (Centigrade). The silver content has little influence on the resistance: it is less the more free cyanide is present. Addition of soda eliminates the "aging" of the bath and reduces resistance. Polarization at the anode is normal, i. e., it increases with increasing c. d. and decreases with rise in temperature. It should not exceed 0.5 volt or, still better, 0.2 volt. The cathodic polarization behaves in the same way but within wider limits; 0.5 v. should be the limit. The throwing power depends very much upon the cathode potential. The following electrolytes are recommended: for sodium cyanide baths, 25g. silver, 30g. free sodium cyanide and 45g. soda per liter (3.1/3, 4 and 6 Av. oz./U. S. gall. respectively), maximum polarization on both anode and cathode O.5v.; for potassium cyanide baths, 25g. silver, 45g. free potassium cyanide and 60-75g. potash per liter (3.1/3, 6 and 8-10 Av. oz./U. S. gall. resp.), with maximum cathodic polarization O.7v. and anodic polarization O.5v. Very bright deposits are obtained with lg./liter (0.134 oz./gall.) sodium thiosulfate and 10cc. 28% ammonium hydroxide per liter, and a c. d. of 0.8 amp./sq. dm. (7.4 amp./sq. ft.): the current efficiency is almost 100% and the deposits are harder than the normal deposits. *C. A.* **27,** 4486 (1933).

Cyanide baths for silver and gold plating. THEWS. *Deut. Goldschmiede-Ztg.* **34,** 433 (1931); *Chem. Zentr.* 1932, I, 126.—"Gray" potassium cyanide containing about 5% potassium cyanate, potassium carbonate and iron is more satisfactory for silver-plating than the pure salt. Increase in impurities, especially potassium carbonate, accounts for the better results obtained with old silver-plating baths.

C. A. **27,** 5007 (1933). M. G. MOORE.

Silver-plating. French patent No. 737,661. May 26, 1932. *Issar Budowski.* Agents reducing the surface tension, such as sodium sulforicinate or derivatives of glutin, are added to baths used for silver-plating.

C. A. **27,** 1579 (1933).

Testing silver and copper electrodeposits. K. W. FROEHLICH. *Mitt. Forschungs-inst. Probieramt Edelmetalle* **7**, 37 (1933).—The new method involves testing of the resistance against wear (friction) of a deposited metal, and consists in letting sand of a certain grain size drop from a definite height and at a definite angle onto the deposit until the basis material appears; the amount of sand used serves as a measure for the wear resistance. The method was used in investigating the influence of composition of the electrolyte upon the wear resistance: definite results were not obtained.

C. A. **27**, 4486 (1933). M. HARTENHEIM

Plating tableware or other metal articles. U. S. patent No. 1,922,005. August 8, 1933. WM. R. STOCKING (to Williams Bros. Mfg. Co.). A spot, such as that which is exposed to greatest wear, is plated, the plating on the spot compacted by pressure, and the entire article then plated with the same metal as that first applied to the spot. *C. A.* **27**, 5048 (1933).

New electrolytic deposits. H. KRAUSE. *Feinmechanik u. Präzision* **41**, 106 (1933).—A review. Platinum, palladium, gold, silver, rhodium, indium, molybdenum, tungsten, etc. are used. Rhodium deposits are recommended where hardness is of importance. It is best deposited from a sulfate bath containing lg. rhodium per liter and requiring 4-6v.; it develops a noxious mist. Molybdenum is deposited from a soln. of 10g. ammonium molybdate and 10-20g. ammonium nitrate in 1 liter of water, with 0.2-0.3 amp./sq. dm. at about 2 v.; a fine black deposit is obtained. *C. A.* **27**, 4486 (1933). M. H.

Alkali platinates (for an electroplating bath). British patent No. 391,119. April 18, 1933. A. Powell, E. Davies, A. Scott and Johnson Matthey and Co. Ltd. A soln. obtained by boiling an alkali metal hydroxide and a compound of quadrivalent platinum, e. g., sodium chloroplatinate is treated with ethyl alcohol, acetone or other organic liquid which is (almost) completely miscible with water, to precipitate a hydrated alkali metal platinate, which is washed, dried and dissolved in an alkaline soln. to form an electroplating bath.

C. A. **27**, 4885 (1933).

Electrodeposition of palladium. U. S. patent No. 1,921,941. August 8, 1933. A. POWELL and E. DAVIES (to Johnson Matthey and Co. Ltd.). A bright adherent palladium deposit is obtained by use of an electrolyte containing in soln. a tetrammine-palladium salt, the acid radical of which is not reduced under the plating conditions, such as tetrammine-palladium sulfate, nitrate, phosphate or chloride, and preferably also a conducting salt, such as sodium sulfate or sodium nitrate, and a small amount of an alkali, such as ammonia, and a colloid, such as 0.01% of dextrin. *C. A.* **27**, 5009 (1933).

Palladium. French patent No. 737,752. May 27, 1932. The Mond Nickel Co. Ltd. Palladium is deposited electrolytically, an anode of palladium being used in an aqueous soln. of an electrolyte capable of dissolving the anode at a speed about equal to that at which palladium is deposited on the cathode The electrolyte may contain an alkali metal, or alkaline earth metal, palladonitrite and an alkali metal, or alkaline earth metal, chloride or bromide.

C. A. **27**, 1579 (1933).

Electrodeposition of metals. German patent No. 564,088. November 8, 1931. W. C. Heraeus G. m. b. H. (Paul Haas, inventor). In the electrodeposition of metals of the platinum group, neutral aqueous solns. of double nitrites of potassium or sodium and a metal of the platinum group are used as

electrolytes. The double nitrites are prepared by treating the corresponding double chlorides with potassium or sodium nitrite. The conductivity of the electrolyte may be raised by adding an organic salt, e. g., an alkali citrate, or by using an excess of alkali nitrite. Electrolysis may be effected at atmospheric temperature. Examples are given. *C. A.* **27,** 913, (1933).

Tantalum solution for use in electroplating. U. S. patent No. 1,922,-847. August 15, 1933. J. B. GRENAGLE (to Wm. Varney and Universal Alloys Inc.) Tantalum penta-chloride ($TaCl_5$) in the form of a paste is treated with carbon heated to redness and while so treated is contacted with chlorine gas, the product being dissolved in an acetonitrile bath. *C. A.* **27,** 5009 (1933).

Copper product perfected: Anaconda makes sound sheets by electrolysis. B. H. STROM. *Eng Mining J.* **134,** 281 (1933).—The present daily capacity of the plant is 6000 linear feet of copper sheet 3 ft. wide and ranging in thickness from 0.0017 to 0.013 inch (1 to 7 oz./sq. ft.). In the first operation a revolving drum, lined with antimonial lead, 66 in. in diameter, 36in. wide, is two-fifths immersed into the electrolyte circulated at 4 gall./min. Anodes of lead containing 6% antimony are spaced 3/4 in. from the cathode surface. The feed analyses 45g./l. copper, 190 sulfuric acid plus goulac as addition agent. As the drum emerges from the cell the sheet is stripped, washed and coiled on a reel. By regulation of drum speed and c. d. any thickness of copper up to 2oz./sq. ft. can be produced. At 140amp./sq. ft. a peripheral speed of 9.5in./min. produces a 1oz./sq. ft. sheet. In the second, or loop, cell copper anodes are used at 40amp./sq. ft. There are 9 loop frames and 10 anodes. The endless sheet passes up and down and over small diameter wooden rolls. The sheets can be built up to any desired weight up to 7oz./sq. ft.

C. A. **27,** 4484 (1933). C. G. FINK.

Electrolytic refining of copper by use of the complex salt of cuprous chloride. Part XII. Behaviour of bismuth. NAOTO KAMEYAMA and SHOJI MAKISHIMA. *J. Soc. Chem. Ind., Japan,* **36,** Suppl. binding, 365 (1933); cf. *C. A.* **26,** 5850-1.—When more than lg./litre bismuth accumulates in the bath, it may reach 0.001% in the cathode deposit. It may also deposit on the anode. Under these conditions the cathode deposit becomes highly crystalline. Avoidance is possible by increase of copper and gelatin in the bath. (See also *The Monthly Review*, October 1933, p. 41. E. B. S.).

C. A. **27,** 4484 (1933). G. M. E.

Coating wire with copper or a copper alloy. British patent No. 390,-305. April 6, 1933. J. G. FRASER. The wire is passed through an acid bath, a rinsing bath, a coating bath, in which it is coated by chemical deposition or electrolytically, and a washing bath, and then through a chamber heated to 500-900° F., the wire being maintained entirely out of contact with the chamber or other parts just prior to and during its passage through the chamber. Apparatus is described. *C. A.* **27,** 4763 (1933).

Nickel-plating of brass. A. W. HOTHERSALL. *Usine* **42,** No. 26, 27 (1933).—The phenomenon that nickel deposits often peel off in subsequent treatment, such as polishing and particularly when put in the bath for chromium plating, was investigated. The principal effort to obtain absolutely reliable adhesion must be directed toward the preparation of a thoroughly clean surface for the nickel deposit. Buffing, chalking, anodic treatment and heating to 250° C. are means employed with more or less success. The best methods known at

present for good adherence of nickel consist in immersing the properly degreased metal in a soln. of nitric acid 30% or more by volume, or a mixture of 530cc. sulfuric acid, 160cc. nitric acid, 0.75cc. hydrochloric acid and 320cc. water; it should be kept in the soln. until it is visibly attacked. The other solns. are 5% potassium cyanide and a soln. containing 50g. citric acid in water neutralised with ammonia and treated with 20g. citric acid dissolved in water, the whole being diluted to 1 liter. The last 2 solns. prevent the formation of the reddish tint often produced by the first acid treatment. (See following abstract. E. B. S.). *C. A.* **27,** 4485 (1933). M. HARTENHEIM.

Adhesion of electrodeposited nickel to brass. A. W. HOTHERSALL. *J. Electroplaters' and Depositors' Tech. Soc.* **7,** 115 (1932). — Heat treatment of nickel coated specimens at 250° C. for two hours improves the adhesion of nickel deposits to surfaces not subjected to etching during cleaning; this is due to removal of hydrogen-embrittlement of copper and brass caused during nickel deposition. A similar improvement in adhesion was generally obtained by the preliminary deposition of a layer of copper from acid copper sulfate soln. followed by nickel deposition. The degree of adhesion increases gradually with the degree of etching. From these results it is concluded that the poor adhesion of electrodeposited nickel to unetched, emeried brass is due partly to embrittlement of the surface layers by adsorption of hydrogen, and partly to the inherently weak condition produced by the emery treatment. The surface layer produced by abrasion is thicker with emeried brass than with buffed brass, so that a deeper etching is required with emeried brass to give the same adhesion. With buffed brass, the material which is particularly weak inherently, and which is principally susceptible to hydrogen-embrittlement, is confined to an extremely thin surface skin; the removal of this skin by means of a suitable etching treatment before nickel deposition results in adherent deposits. Preparation of brass or copper surfaces for electroplating should include a treatment for removing surface oxide films. A boiling alkaline cleaner for removal of grease is necessary (cf. Loven, *Met. Ind. N. Y.* 29, 291,338 (1931)). The presence of powdery metallic films deposited during electrolytic cleaning of the cathode causes poor adhesion. Nickel anodes have less tendency than iron anodes to give such deposits when used in alkaline cleaning solns. The final preparation of a polished brass cathode for electrodeposition by light anodic etching is recommended. Etching with nitric acid, or with mixtures containing nitric acid, cannot be satisfactorily controlled. Solns. used for the anodic etching of brass were: (1) 5% potassium cyanide soln. and (2) a soln. containing citric acid and ammonium citrate, prepared by dissolving 50g. citric acid in water, neutralising with ammonia, adding 20g. citric acid dissolved in water and diluting to 1 liter. The citric acid soln. is somewhat preferable. Treatment of buffed brass at 10amp./sq. ft. for 30 seconds yields highly adherent nickel deposits on a number of different types of brass without appreciably affecting the polished appearance. Tables showing quantitative results of adhesion tests and of various factors on adhesion are given.

C. A. **26,** 3732 (1932). EDWARD B. SANIGAR.

Throwing power and current efficiency of the nickel-plating solution at high and low pH. RUSSEL HARR. *Trans. Electrochem. Soc.* **64,** 15pp. (preprint) (1933).—The throwing power (T. P.) of solns. of high pH (low acidity) is better than that of solns. of low pH (high acidity) under all conditions

of temperature and c. d. The T. P. of all solns. is improved by raising the temperature. The T. P. of solns. of low pH increases with increase of c. d., while that of solns. of high pH decreases. Increasing the concentration of nickel sulfate from 300 to 450 g./liter causes a small decrease of T. P. for solns. of high pH and a small increase for T. P. for solns. of low pH. Hydrogen peroxide has very little effect on T. P. in solns. of high pH because of its rapid decomposition. In solns. of low pH it may reduce T. P. very seriously by the formation of soluble ferric salts. Ferrous iron has no effect on T. P. Ferric iron (soluble only in solns. of low pH) is most effective in reducing T. P.

C. A. **27,** 4740 (1933).

Uniform corrosion anode. Canadian patent No. 333, 247. June 13, 1933. G. F. GEIGER (to The International Nickel Co. Inc.). To a melt of commercial nickel is added 0.002 - 0.020% sulfur. Oxygen (0.02 - 0.25%) is introduced by "flapping" and the melt is poured. The ingots formed are forged, rolled to anode shape and cooled in water containing alcohol.

C. A. **27,** 4525 (1933).

Electroplating. British patent No. 383,842. November 24, 1932. B. J. R. EVANS and IMPERIAL CHEMICAL INDUSTRIES. Small articles with polished surfaces are plated with a uniform thin coating, e. g., 0.001 inch, of metal while supported in a thin layer, preferably a single layer, on a cathode tray on which they are rolled or slid gently and without shock. The method in applicable to the nickel-plating of lead bullets. Apparatus is described.

C. A. **27,** 5008 (1933).

Chromium-plating. M. BROICH. *Metallbörse* **23,** 733 (1933).—The applications of chromium-plating are reviewed. The bath composition, precautions for preventing corrosion of the bath and obtaining satisfactory deposits, and methods of control analysis are discussed in general. Best results are obtained by plating for about 10 minutes at a temperature of 45°C. and a c. d. of 1000amp./cubic meter; this produces a deposit 0.0001 - 0.0002cm. in thickness. Hard lead is most suitable for anodes. Iron, steel, nickel, copper, nickel and copper alloys may be plated directly. Intermediate nickel-plating offers better corrosion resistance than either nickel or chromium-plating alone, and the preparation of the surface to be plated is discussed. The construction of the plating vat, and hazards in operation, are mentioned.

C. A. **27,** 4485 (1933). A. S. SMITH.

Experiments on the electrolytic deposition of chromium alloys from baths free from chromic acid. H. CASSEL. *Oberflächentechnik* **10,** 158 (1933).—The chromium deposition from chromic acid is usually of sexivalent chromium, but it can also be bivalent, in which case there would be a saving in energy. Tests were made with a bath of chromium hydroxide reacting with sulfuric acid, hydrochloric acid and hydriodic acid. The ability of chromium to combine with the base depends on the overvoltage of chromium against the the base, copper or brass as cathodes. This ability increases during electrolysis while that of hydrogen decreases. The increase of overvoltage of hydrogen can be affected by working at a low temperature (18°C.) or by adding neutral salts. Hydrogen must be pushed away from the layer on the cathode into the electrolyte to keep it away from the deposited layer. Although this can be done successfully with electrolytes of this kind, the baths are, however, not very lasting. On the other hand, the dispersion factor is very good and the energy

consumption only 75% of that of chromic acid electrolytes. The formation of chromium alloys with zinc, cadmium, silver, tin, lead-mercury, arsenic, iron and nickel was tried but no promising results of practical value were obtained.

C. A. **27,** 4485 (1933). M. HARTENHEIM.

Electrodeposition of chromium. U. S. patent No. 1,922,853. August 15, 1933. H. KISSEL (to United Chromium Inc.). A firmly adherent, ductile chromium deposit is produced by passing an electric current through a bath containing a soln. of a trivalent chromium compound maintained as nearly neutral as possible and to which are also added substances such as alcohol, glycerol or sugar which retain the basic compounds of the metal in soln.

C. A. **27,** 5009 (1933).

The practical aspect of cold chrome plating. EUGEN WERNER. *Oberflächentechnik* **10,** 179 (1933).—In spite of many objections reported, Werner proves from practical experiences that chromium plating at about 20° C gives entirely satisfactory results. With the proper electrolyte, bright and dense deposits are obtained. The presence of other acids in the bath does not have as important an influence at low as at high temperature.

C. A. **27,** 5007 (1933). M. HARTENHEIM.

Nickel-chromium plating. H. HORNAUER. *Emailletech. Monatsblätter* 1932 (April), 27. — Easy rusting and scaling of chromium-plated articles are due to a faulty basis plating of nickel. The nickel-plating must be free from pores, tightly adherent and low in hydrogen. In degreasing the article before nickel-plating and chromium-plating, only well-tried degreasing baths should be used. Iron and steel parts should be given a thin copper deposit before being nickel-plated. The use of the rapid nickel-plating bath "Auto-Rapid" is suggested; the bath is heated to about 35-40° C.

Metal Abstracts (in *Metals and Alloys*) **4,** 67 (1933).

Electrodeposition of chromium. U. S. patent No. 1, 917,188. July 4, 1933. WM. S. EATON (one-half to W.W.Burns). A bath for chromium deposition is prepared by mixing an aqueous soln. of chromic acid with sodium compounds such as caustic soda, sodium sulfate and sodium carbonate, the ratio of the chromic acid to the sodium compound being at least 2:1.

C. A. **27,** 4488 (1933).

Electrodeposition of chromium. German patent No. 579,067. June 21, 1933. SIEMENS and HALSKE A.-G. (Charles H. Eldridge, inventor). The anodes and other parts of the apparatus which come into contact with the electrolyte are made of or lined with lead-tin alloy consisting mainly of lead, preferably with lead-tin alloy containing 3-10% of tin. *C. A.* **27,** 4488 (1933).

Chromium-plating. U. S. patent No. 1,918,605. July 18, 1933. E. M. JONES (to Parker Rust-Proof Co.). Apparatus and various details of operation are described which may involve revolving an anode around the article being plated, and otherwise moving the anode so that its surface is maintained at a substantially constant distance from that of the article being plated.

C. A. **27,** 4744 (1933).

Lead-plating. H. KRAUSE. *Feinmechanik u. Präzision* **40,** 106 (June 1, 1932).—The methods for obtaining a dense, non-porous, sufficiently thick and uniformly thick coating of lead, especially on iron and steel surfaces, are reviewed. Besides the older methods of lining by first tinning and then melting the desired thickness of lead on the surface, electrolytic methods have been

developed more recently even for thicknesses up to 10mm. 2/5 inch). Electrolytically deposited lead is softer than melted-on lead; with this method, metals like aluminum or cast iron, for which the melting method fails, can be lead-coated. For lead electroplating the basis metals must be properly cleaned by sand-blasting. Copper and its alloys must first be nickel-plated or tinned. A lead thickness of 0.075mm. (0.003 in.) is generally sufficient for a dense coating: for chemical apparatus a thickness of 1.75 mm. (0.07 in.) is required. High voltage and high c.d. give best results; otherwise the coatings may be porous. Thinner coatings can be produced in alkaline baths, thicker ones have, for years, been made in hydrofluosilicic, hydrofluoboric, and perchlorate baths. In addition, the following electrolyte is recommended: 8.25 kg. (18 1/5 lb.) lead silicohydrofluoride, 7 kg. (15 1/2 lb.) silicohydrofluoric acid, 10g. (1/3 oz.) gelatin, 100 liters (26 2/5 U. S. gall.) water; c. d. about 1 amp./sq. dm. (9 1/3 amp./sq. ft.), bath voltage 0.15-0.2v.

Metal Abstracts (in Metals and Alloys) **4**, 113 (1933).

Electrodeposition of lead from dithionate baths. R. L. BATEMAN and F. C. MATHERS. *Trans. Electrochem. Soc.* **64**, 8 pp. (preprint) (1933).—Excellent cathode deposits of lead can be obtained easily from a soln. containing 4% of lead dithionate and 2% free dithionic acid together with glue and B-naphthol as addition agent, in quantities of 0.005% or more each. In general, hydroxy aromatic compounds, such as B-naphthol, cresol, etc., used with glue are good addition agents. *C. A.* **27**, 4740 (1933). C. G. FINK.

Plating lead with other metals by electrodeposition. U. S. patent No. 1,918,159. July 11, 1933. L. WEISBERG and W. F. GREENWALD (to Weisberg and Greenwald Inc.). Lead, or metal containing lead, is prepared for electroplating with metals such as copper, brass or nickel by subjecting the surface, as anode, to electrolysis in a neutral or alkaline electrolyte such as a sodium acetate soln. *C. A.* **27**, 4488 (1933).

Testing thickness of zinc on galvanised wire. Z. DYAKONOVA. *Tzvetnuie Metal* 1932, 550.—By the use of a soln of arsenious oxide (As_2O_3) in sulfuric acid, zinc oxide and zinc can be uniformly dissolved. By dipping a wire, previously cleaned in benzene or ether, into such a soln. and keeping it in the soln. for 15 seconds from the moment of the appearance of the first bubbles, a layer of zinc 0.0001cm. (4-hundred thousandths in.) is dissolved off. The wire is then washed in water and quickly dipped into a concentrated soln. of ammonium sulfide; if any bare wire is present, black spots — due to the formation of ferrous sulfide—will appear on the portions of the wire unprotected by zinc. To ascertain the presence of ferrous sulfide, the wire is placed for a short time in strong acetic acid (3cc.), removed, and 2-3 drops of potassium ferricyanide added to the soln. Change in the color of the soln. (to blue) indicates the presence of iron. (See MONTHLY REVIEW. September 1933, Abstract 1, fora some what similar test for the thickness of cadmium coatings. E.B.S.) *C. A.* **27**, 4514 (1933).

Electrodeposition of tin. U. S. patent No. 1,919,000. July 18, 1933. C. J. WERNLUND and F.F. OPLINGER (to E. I. du Pont de Nemours and Co.). For diminishing the ratio of caustic alkali to alkali metal stannate concentration in an aqueous tin-plating soln. containing these substances, the soln. is treated with an acid, such as acetic acid, and an oxidising agent, such as hydrogen peroxide or other peroxide, permanganate, persulfate or perborate. *C. A.* **27**, 4743 (1933).

Electrodeposition of iron. French patent No. 747,706. June 22, 1933. Allgemeine Elektricitäts-Gesellschaft. Iron is deposited electrolytically from hot solns. of iron salts, the action being started with a c.d. considerably below normal (2 amp./sq.dm., =18.58 amp./sq. ft.), and increased gradually to normal (5 amp./sq. dm., =46 amp./sq. ft.) during about 30-45 minutes. Separation of the deposit from the basis metal is thereby avoided.
C. A. **27,** 5009 (1933).

Simultaneous electrodeposition of nickel, iron and cobalt to form a uniform magnetic alloy. U. S. patent No. 1,920,964. August 8, 1933. R.M.Burns (to Bell Telephone Lab. Inc.). Various details are described involving the use of a sulfate and a chloride of each of the metals in an electrolytic bath, together with a buffer mixture such as boric acid and sodium sulfate. *C. A.* **27,** 5009 (1933).

Prevention of corrosion of iron or its alloys. Japanese patent No. 98,580. December 9, 1932. The Head of the Kinzoku-Zairyô Kenkyûzyo (Hikozô Endô and Haruzirô Sekiguti, inventors). By boiling iron or its alloys in ferric oxalate soln. acidified with oxalic or phosphoric acid, the metal is firmly covered with a thin protective film of ferrous and ferric oxalates.
C. A. **27,** 4770 (1933).

Coating aluminum or aluminum alloy surfaces. British patent No. 388,787. March 3, 1933. Vereinigte Aluminum-Werke A.-G. Aluminum or aluminum alloy articles with a surface oxide layer produced electrolytically are treated with a soln., preferably hot, of substances which soften and loosen the oxide layer and make it flexible, the oxide layer being then impregnated with filling, binding or insulating substances, e. g., paraffins, oils, waxes, lacquers, resins. In examples, caustic soda and potassium chlorate are used as softening and loosening agents. *C. A.* **27,** 4763 (1933).

Colored coatings on aluminum. British patent No. 387,806. February 16, 1933. MARTIN TOSTERUD (to R. S. Dunham). Articles of aluminum or alloys containing at least 50% aluminum are colored by producing an absorbent aluminum oxide coating thereon, e. g., by applying solns. of sulfuric acid, chromic acid, sodium sulfate, sodium hydrogen sulfate, sodium carbonate, potassium dichromate, phosphoric acid and its salts, ammonium citrate or lactate, or citric acid, and coloring the coating by a mordanted basic dyeing compound. Examples are given. *C. A.* **27,** 4763 (1933).

Electrolytic production of metals. German patent No. 581,013. July 20, 1933. SIEMENS and HALSKE A.-G. (Günther Hänsel, inventor). Easily removable deposits are obtained by using cathodes made of magnesium or magnesium alloy, e. g., of Electron metal. *C. A.* **27,** 5009 (1933).

Cleansing compositions. British patent No. 391,156. April 18, 1933. P. W. Denny and Imperial Chemical Industries Ltd. Chlorinated hydrocarbons containing 2 carbon atoms, e. g., trichlorethylene, are stabilized by adding a small proportion of an alkylamine, e. g., dibutylamine, mono-, di-, and tri-ethylamine, which prevents the liberation of acid in degreasing metals and fabrics. A small quantity of an alkali substance, e. g., calcium hydroxide, which is capable of decomposing the hydrochloride of the added amine, may be added.
C. A. **27,** 4892 (1933).

The electrodeposition of rubber from Revertex and Revultex. N. BUDILOFF. *Kautschuk* **9**, 1, 20, (1933).—The practicability of making rubber products by the electrodeposition of rubber from concentrated latex (Revertex) and vulcanised concentrated latex (Revultex) directly on metal was studied. Unlike latex, deposition from Revertex alone on zinc electrodes was not uniform, but by neutralization with ammonia a smooth, compact uniform deposit was obtained, and corrosion of the zinc anode was overcome. The best results were had with 10cc of ammonia (density 0.91) in 250cc. of Revertex (diluted 1:1). On the other hand, caustic potash, di-, and trimethylamine, pyridine and water glass were of no benefit. At a given temperature, the amount of rubber deposited was roughly proportional to the amount of electricity and to the concentration of rubber (cf. Sheppard, *Trans. Am. Electro-chem. Soc.* **52**, 47 (1927) and *C. A.* **21**, 1901; Klein, *C. A.* **23**, 2067). The best yields were obtained with a c. d. of 0.1 amp./sq.dm. (1 amp./sq. ft.), and the yields were improved by interrupting the electrolysis and leaving the zinc anode in contact with the Revertex, and also by the addition of electrolytes the best of which was ammonium acetate. All these phenomena indicate that the electrodeposition of rubber is a secondary process at the electrodes, and that it has been explained adequately by Sheppard (above reference). With ammonium acetate present, acid ions which collect at the anode have a coagulating effect in addition to that of the zinc ions. Experiments with other metals for anodes, with and without ammonia, showed that in absence of ammonia, cadmium, iron, lead and tin are all unsatisfactory, that with ammonia, cadmium is as good as zinc, while lead, tin and nickel are unsatisfactory. With nickel, the films became tacky on aging. The pecularities of the deposits obtained with the various metals are explained by the solubility of the metals in alkaline soln. and the action of the resulting oxides or hydroxides. Dipping the deposits in aqueous ammonium polysulfide gave unsatisfactory vulcanizates, and addition of ammonium polysulfide to Revertex gave very poor deposits. However, sulfur, zinc oxide, clay, whiting, carbon black and inorganic colors were put in permanent suspension in Revertex by the use of suitable protective agents (ammonium ricinoleate is particularly recommended as an additional reagent), which by vulcanization in hot aqueous piperidine pentamethylenedithiocarbamate yield vulcanizates of normal quality. The same series of experiments was carried out with diluted Revultex, but with carbon cathodes. Here, too, ammonia was necessary, with the best results at 15cc. ammonia per 250cc. of Revultex (diluted 1:1). Additions of fillers offered no difficulties. As with Revertex, zinc and cadmium were the only satisfactory anodes. Deposits from Revultex containing no ammonia swelled greatly in water and became fragile, whereas those prepared with ammonia did not swell and remained strong and elastic. (Cf. paper by A. Hirsch on rubber electrodeposition, MONTHLY REVIEW. January 1933, p. 39. E. B. S.). *C. A.* **27**, 4125 (1933).

Cleaning porous electrodepositing molds. U. S. patent No. 1,917,039. PAUL KLEIN and ANDREW SZEGVARI (to American Anode Inc.) Solid particles are removed from the pores of the mold by forcing a fluid, such as ammonia soln., through them, and the mold is immersed in an electrolytic soln. and an electric current is passed in a direction opposite to that used in electrodeposition. *C. A.* **27**, 4488 (1933).

ABSTRACTS FROM THE EDUCATIONAL COMMITTEE

T. F. SLATTERY, CHAIRMAN

Micro-Organisms in Plating Solutions

E. A. Ollard. Metal Industry (London) Jan. 6, 1933

Scums that form on plating baths are usually attributed to dust, etc. Microscopic examination of scum from solutions that had been carefully filtered and kept covered, however, showed that a living organism was present. This is apparently a fungus, which may occur with large or with small fibres. It takes up iron, and may be allied to the "iron bacteria." A single cell organism observed at high magnification may be a spore cell.

This fungus grows in both nickel and acid copper baths under a wide range of conditions. Hydrogen peroxide and formaldehyde do not appear to affect it much, but phenol and sodium fluoride seem to kill it. It may occur in baths other than those noted, but is not likely to be present in chromic acid or cyanide baths.

Possible relations to pitting or to chemical changes producing addition agents are pointed out by the author. C. T. THOMAS

Platinum Plating — A. E. Smith

Metal Industry (London) Sept. 1, 1933

Corrosion tests on platinum deposited on silver plated brass strips showed that, like chromium, pores in the deposit permit corrosion, even though the coating is resistant. Indoors, there is no tarnish in months of exposure. Outdoors, periodic wiping is necessary and the surface is soon impaired.

Chromium plating is harder and cheaper, but platinum has a more pleasing color, and the bath has better throwing power. C. T. THOMAS

Platinum Plating

Metal Industry (London) Aug. 12, 1932.

Platinum plating, under a new process carried on in Birmingham, England, is claimed to be untarnishable, tough, and adhesive. Uses on jewelry, surgical instruments, and electrical contacts are suggested. C. T. THOMAS

New Platinum Plating Process

Metal Industry (London) Dec. 16, 1932

Elaborating on the above process, it is stated that the solution is made from patented salts, dissolved in water. Platinum plated anodes are used. The bath is replenished when necessary with fresh salts. Six to eight amperes per square foot are used.

Grades of plating to last twenty, ten or five years are established. The appearance of the deposit is very pleasing. For jewelry, it is estimated that the platinum plated article will cost about 25% more than the gilt. C. T. THOMAS

JOHN C. OBERENDER

CONGRATULATIONS are in order for John C. Oberender, New England sales manager for The Zapon Company, Stamford, Conn., who celebrated the 30th anniversary of his wedding on November 25. Mr. Oberender's headquarters is at the New Haven office of Zapon.

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Please mention THE MONTHLY REVIEW *when writing*

John C. Oberender is one of the best known men in the metal finishing supply industry. He is acquainted with platers and finishers throughout the country, being a familiar figure at conventions and meetings of the industry. Mrs. Oberender is also well known to the trade, as she has accompanied him to many conventions of the Electro-Platers' Society and to annual branch meetings at various cities.

Mr. Oberender began his career as a metal finisher for the Eberhard Faber Pencil Company in Brooklyn, N. Y. He became head of the lacquering and finishing rooms. In 1913 he went to the American Hardware Company's P. and F. Corbin division at New Britain, Conn., first as lacquer department foreman, then as head of plating and finishing also. In 1918 he joined Zapon, taking charge of sales in western Connecticut. He went to the Chicago offices in 1921, as assistant manager, and in 1923 was made New England sales manager.

This industry will join us in wishing John Oberender and his wife continued success in their respective fields of endeavor.

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